Global Carbon Cycle

Information Sheet FY2009

The goal of the Climate Program Office's Global Carbon Cycle (GCC) program is to improve our ability to predict the fate of anthropogenic carbon dioxide (CO_2) and future atmospheric CO_2 concentrations using a combination of atmospheric and oceanic global observations, process-oriented field studies, and modeling. GCC seeks to fund scientifically important research projects that could lead to improved support of the NOAA missions, products and services that relate to the global carbon cycle. This year GCC is especially interested in proposals on the topics described below. This is not an exclusive list and investigators who have other ideas are also encouraged to submit a Letter of Intent briefly describing the scientific merit and relevance to NOAA of their proposal topic.

Optimal Carbon Observing Networks

GCC is particularly interested in developing the ability to resolve carbon sources and sinks seasonally and at regional scales. Such resolution is necessary to answer many scientifically important questions about the dynamics of the carbon cycle, but also to support decision-making and to evaluate and verify the carbon impact of various management choices. This capability will require dramatically increasing existing measurement efforts and making good use of rapidly improving modeling capabilities both to plan the measurement activities and to invert the data stream. Studies could include formulation of radically new observation concepts, Observing System Simulation Experiments that estimate the optimal network structure, and the development of low-cost, accurate instrumentation with the potential to be deployed autonomously in large numbers for atmospheric or oceanographic measurements of carbon-related parameters.

Causes of Variability in Sources and Sinks

The rate of increase of carbon dioxide in the atmosphere can vary significantly on interannual and decadal time-scales. The causes of this variability are unknown; while a small amount is a result of variations in emissions, the majority seems to be due to variability in uptake by the oceans and terrestrial biosphere. For better projections we need to understand key processes that control the sources and sinks of carbon in oceanic and terrestrial systems. Examples for these include the influence of persistent weather and ocean circulation patterns on biological productivity, impacts of acidification on the oceanic carbon cycle, and the possibility of rapid release of carbon from warming high latitudes. Better understanding of such processes may be attained through either targeted field studies and modeling, or through the integration of carbon parameters into existing observational and modeling efforts. Proposals taking either approach will be entertained, but the significant cost efficiencies typical of the second approach are strongly encouraged.

Future Atmospheric Carbon Dioxide Concentrations

Current models used to project future atmospheric carbon dioxide concentrations assume that the carbon cycle will continue to operate in the same way it has operated in the recent past. These models do not take into account limitations on the terrestrial carbon sink, or how biological, chemical and physical processes in the ocean and land might change either due to natural variability or external forcing. By examining the carbon cycle as an integrated system, identifying how it interacts with climate and other influences, and incorporating the carbon cycle into dynamic earth system models, more realistic predictions of future atmospheric carbon dioxide concentrations and potential abrupt changes in growth rate can be made.